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Listing of Claims

The following listing of claims will replace all prior versions, and listings, of claims in the subject application:

Claim 1 (canceled).

2. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 1 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles; and
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower than those of
other wall surfaces and configured to absorb a pressure change,
wherein said pressure absorbing surface is formed by a pressure absorbing member
having a non-uniform thickness, and
wherein the pressure absorbing surface is divided into a central portion and two end portions on both sides of the central portion along the predetermined direction, and an average thickness of the pressure absorbing member at the central portion is larger than an average thickness of the pressure absorbing member at the end portions.

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Claim 3 (canceled).

4. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 3 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles; and
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower than those of
other wall surfaces and configured to absorb a pressure change,
wherein said pressure absorbing surface is formed by a pressure absorbing member
having a non-uniform thickness,
wherein the pressure absorbing member has a thin portion and a thick portion having at
least two kinds of thicknesses, and
wherein the thick portion is provided at a central portion of the pressure absorbing
member along the predetermined direction, and the thin portion is provided on both sides of the
central portion of the pressure absorbing member along the predetermined direction.

5. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 3 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each

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communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member having a non-uniform thickness,

wherein the pressure absorbing member has a thin portion and a thick portion having at least two kinds of thicknesses, and

wherein the pressure absorbing member has a stacked structure made up of a plurality of layers, and a number of layers of the stacked structure forming the thin portion is different from a number of layers of the stacked structure forming the thick portion.

6. (currently amended) [[The]] A recording head as claimed in claim 3 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of

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other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member
having a non-uniform thickness,

wherein the pressure absorbing member has a thin portion and a thick portion having at
least two kinds of thicknesses, and

which wherein the recording head satisfies a relationship

$$2 \times 10^{10} < U_d^2 \times U_y^{-2.5} \times U_x^{-3.5} \times E^{2/3} < 9 \times 10^{10}$$

where U_d (m) denotes a thickness of the thin portion, U_y (m) denotes a length of the thin portion along a direction perpendicular to the predetermined direction, U_x (m) denotes a length of the thin portion 22 the predetermined direction, and E (Pa) denotes a Young's modulus of the thin portion.

7. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 1 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles; and
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower than those of
other wall surfaces and configured to absorb a pressure change,
wherein said pressure absorbing surface is formed by a pressure absorbing member

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having a non-uniform thickness, and

wherein the pressure absorbing member has a Young's modulus of 100 MPa or greater.

8. (currently amended) The recording head as claimed in claim [[1]] 2, wherein the pressure absorbing member is made of nickel.

9. (currently amended) The recording head as claimed in claim [[3]] 4, which satisfies a relationship

$$0.25 < U_x/T_x < 0.45$$

where U_x (μm) denotes a length of the thin portion along the predetermined direction X and T_x (μm) denotes a total length of the pressure absorbing member along the predetermined direction.

10. (original) The recording head as claimed in claim 2,
wherein the end portions of the pressure absorbing member includes a second thick portion provided in a portion thereof.

11. (original) The recording head as claimed in claim 10, wherein the thick portion and the second thick portion of the pressure absorbing member have the same thickness.

12. (currently amended) The recording head as claimed in claim [[1]] 2, further comprising:

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a vibration plate forming at least one surface of the pressure-applied chambers,
wherein a layer forms said vibration plate and at least a portion of the pressure absorbing member.

13. (currently amended) A line type recording head comprising a recording head as ~~claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member having a non-uniform thickness, and

wherein the pressure absorbing surface is divided into a central portion and two end portions on both sides of the central portion along the predetermined direction, and an average thickness of the pressure absorbing member at the central portion is larger than an average thickness of the pressure absorbing member at the end portions.

Claim 14 (canceled).

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15. (currently amended) A line type recording head comprising a recording head as ~~claimed in claim 14~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

at least one of the wall surfaces of the common chamber, along the predetermined direction, having a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

said pressure absorbing surface being formed by a pressure absorbing member having a plurality of portions with different rigidities.

16. (currently amended) A carriage comprising:

a recording head ~~as claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

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fluid to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower
than those of other wall surfaces and configured to absorb a pressure change,
wherein said pressure absorbing surface is formed by a pressure absorbing member
having a non-uniform thickness, and
wherein the pressure absorbing surface is divided into a central portion and two end
portions on both sides of the central portion along the predetermined direction,
and an average thickness of the pressure absorbing member at the central portion
is larger than an average thickness of the pressure absorbing member at the end
portions; and
a fluid cartridge configured to supply the fluid to the recording head.

17. (currently amended) A carriage comprising:

a line type recording head as claimed in claim 14 including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and
each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the
fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-
applied chambers,

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wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower
than those of other wall surfaces and configured to absorb a pressure change, and
wherein said pressure absorbing surface is formed by a pressure absorbing member
having a plurality of portions with different rigidities; and
a fluid cartridge configured to supply the fluid to the recording head.

18. (currently amended) An image forming apparatus comprising:

a recording head ~~as claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and
each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the
fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a pressure absorbing surface with a rigidity lower
than those of other wall surfaces and configured to absorb a pressure change,
wherein said pressure absorbing surface is formed by a pressure absorbing member
having a non-uniform thickness, and
wherein the pressure absorbing surface is divided into a central portion and two end
portions on both sides of the central portion along the predetermined direction,
and an average thickness of the pressure absorbing member at the central portion

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is larger than an average thickness of the pressure absorbing member at the end portions;

a fluid cartridge configured to supply the fluid to the recording head; and

a ~~cartridge~~ carriage, accommodating the recording head and the fluid cartridge, configured to move in a main scan direction which is perpendicular to the predetermined direction.

19. (currently amended) An image forming apparatus comprising:

a line type recording head as claimed in claim 1 including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change, and wherein said pressure absorbing surface is formed by a pressure absorbing member having a plurality of portions with different rigidities;

a fluid cartridge configured to supply the fluid to the recording head; and

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a ~~cartridge~~ carriage, accomnodating the recording head and the fluid cartridge,
configured to move in a main scan direction which is perpendicular to the predetermined
direction.

Claim 20 (canceled).

21. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the
pressure absorbing member has a continuous surface forming the damper surface.

22. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the
region is arranged on both ends of said at least one of the wall surfaces of the common chamber
along the predetermined direction.

23. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 20 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles;
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers; and
a plurality of pressure converting means for varying pressures within the pressure-applied
chambers, wherein:
at least one of the wall surfaces of the common chamber, along the predetermined

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direction, has a damping surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure by vibration.

said damping surface is formed by a pressure absorbing member which partially has a region where no damping surface is formed, such that the damping surface extends for a length along the predetermined direction less than a total length of the common chamber along the predetermined direction.

at least a portion of wall surfaces forming the pressure-applied chambers has a rigidity lower than the other wall surfaces to form a vibration plate of the pressure converting means, and both the vibration plate and the damper surface are formed by a common first layer.

24. (original) The recording head as claimed in claim 23, further comprising:
a second layer partially formed on the common first layer and forming the region,
said common first layer extending in the predetermined direction and forming the damper surface by a surface thereof not having the second layer formed thereon.

25. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the damper surface has an elasticity lower than those of the other wall surfaces of the common chamber.

26. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 20 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each

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communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a damping surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure by vibration,

wherein said damping surface is formed by a pressure absorbing member which partially has a region where no damping surface is formed, such that the damping surface extends for a length along the predetermined direction less than a total length of the common chamber along the predetermined direction, and

wherein an elasticity G_d (Pa) of the pressure absorbing member forming the damper surface satisfies a relationship

$$1.0 \times 10^{-13} < L_x^{-1} \times L_{dx} \times L_{dy} \times T_d^{-0.3} \times G_d^{-1} < 2.0 \times 10^{-13}$$

where L_x (m) denotes a length of the common chamber along the predetermined direction, L_{dx} (m) denotes a length of the damper surface of the pressure absorbing member along the predetermined direction, L_{dy} (m) denotes a length of the damper surface of the pressure absorbing member along a direction perpendicular to the predetermined direction, and T_d (m) denotes a thickness of the pressure absorbing member forming the damper surface.

27. (currently amended) A carriage comprising:

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a recording head ~~as claimed in claim 20~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-

applied chambers.

wherein at least one of the wall surfaces of the common chamber, along the

predetermined direction, has a damping surface with a rigidity lower than those of

other wall surfaces and configured to absorb a pressure by vibration.

wherein said damping surface is formed by a pressure absorbing member which

partially has a region where no damping surface is formed, such that the damping

surface extends for a length along the predetermined direction less than a total

length of the common chamber along the predetermined direction; and

a fluid cartridge configured to supply the fluid to the recording head.

28. (currently amended) An image forming apparatus comprising:

a recording head ~~as claimed in claim 20~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles;

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a common chamber having a plurality of wall surfaces and configured to supply the
fluid to the pressure-applied chambers; and
a plurality of pressure converting means for varying pressures within the pressure-
applied chambers,
wherein at least one of the wall surfaces of the common chamber, along the
predetermined direction, has a damping surface with a rigidity lower than those of
other wall surfaces and configured to absorb a pressure by vibration,
wherein said damping surface is formed by a pressure absorbing member which
partially has a region where no damping surface is formed, such that the damping
surface extends for a length along the predetermined direction less than a total
length of the common chamber along the predetermined direction;
a fluid cartridge configured to supply the fluid to the recording head; and
a ~~cartridge~~ carriage, accommodating the recording head and the fluid cartridge,
configured to move in a main scan direction which is perpendicular to the predetermined
direction.

Claim 29 (canceled).

30. (currently amended) The recording head as claimed in claim [[29]] 33, wherein a
member forming the free vibration surface integrally forms a surface of the pressure-applied
chamber.

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31. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles; and
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber has a free vibration
surface having thick portions and thin portions, and
wherein a member forming the free vibration surface has a stacked structure made up of a plurality of stacked layers.

32. (original) The recording head as claimed in claim 30, wherein the thick portions have a thickness equal to a thickness of a member forming a wall surface of the pressure-applied chamber.

33. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:
a plurality of nozzles for ejecting a fluid;
a plurality of pressure-applied chambers arranged in a predetermined direction and each
communicating with a corresponding one of the nozzles; and
a common chamber having a plurality of wall surfaces and configured to supply the fluid
to the pressure-applied chambers,
wherein at least one of the wall surfaces of the common chamber has a free vibration

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surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration surface where a width of the free vibration surface along a direction perpendicular to the predetermined direction narrows compared to other portions.

34. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the common chamber where a cross sectional area of the common chamber cut along a direction perpendicular to the predetermined direction decreases compared to other portions.

35. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid

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to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration surface having thick portions and thin portions, and

wherein a cross sectional area of the common chamber cut along a direction perpendicular to the predetermined direction decreases towards an end portion of the common chamber along the predetermined reaction.

36. (currently amended) A carriage comprising:

a recording head ~~as claimed in claim 29~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration

surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration

surface where a width of the free vibration surface along a direction perpendicular

to the predetermined direction narrows compared to other portions; and

a fluid cartridge configured to supply the fluid to the recording head.

37. (currently amended) An image forming apparatus comprising:

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a recording head ~~as claimed in claim 29~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration

surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration

surface where a width of the free vibration surface along a direction perpendicular

to the predetermined direction narrows compared to other portions;

a fluid cartridge configured to supply the fluid to the recording head; and

a ~~carriage~~ carriage, accommodating the recording head and the fluid cartridge,

configured to move in a main scan direction which is perpendicular to the predetermined direction.